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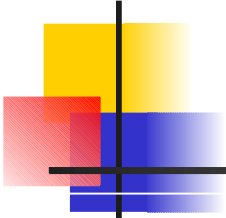
ϕ meson production in Au–Au and d–Au collision at $\sqrt{s_{NN}} = 200$ GeV

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(for the *PHENIX* collaboration)



Fall DNP Meeting, 2003



Outline



Physics motivation

Experimental Setup

Hadron PID in Run2 and Run3

Data analysis procedure

Run2 Au–Au analysis

- Invariant mass spectra
- Preliminary dN/dy
- Recent status

Status of Run3 d–Au analysis

- Invariant mass spectra

Summary and outlook

Physics Motivation

- $\phi \rightarrow s \bar{s}$ **bound state**

- sensitive to strangeness enhancement
- interacts weakly in hadronic matter
- probe of deconfined phase

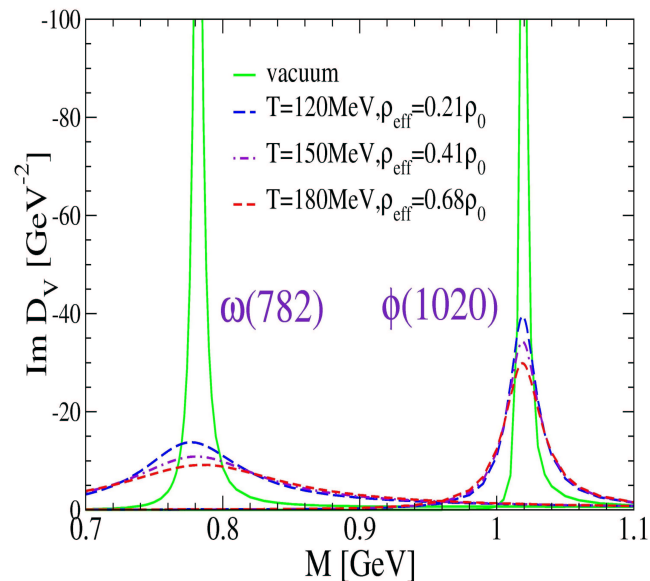
- **Probe of chiral symmetry restoration**

Medium induced effects

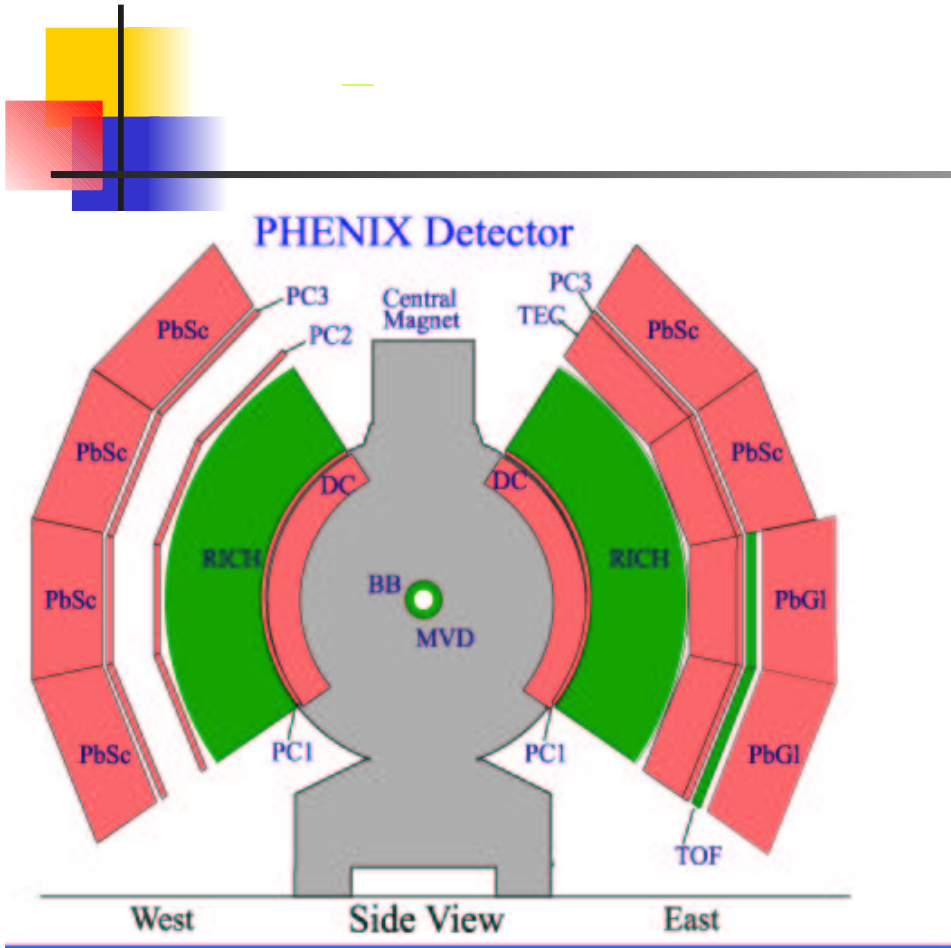
- Mass shift
- Broadening of width
- Double peak structure

- Important to study the difference in the ϕ spectra and yields in Au–Au and d–Au collisions to understand and distinguish between the properties of hot and dense matter created in these collisions.
- PHENIX experiment at RHIC measures ϕ signals in both Au–Au and d–Au collisions.

R. Rapp nucl-th/0204003



PHENIX Setup



- Tracking:



DC – PC

Provides momentum

- $\phi \rightarrow K^+ K^-$

Kaon id : TOF or EMCAL

a) TOF acceptance:

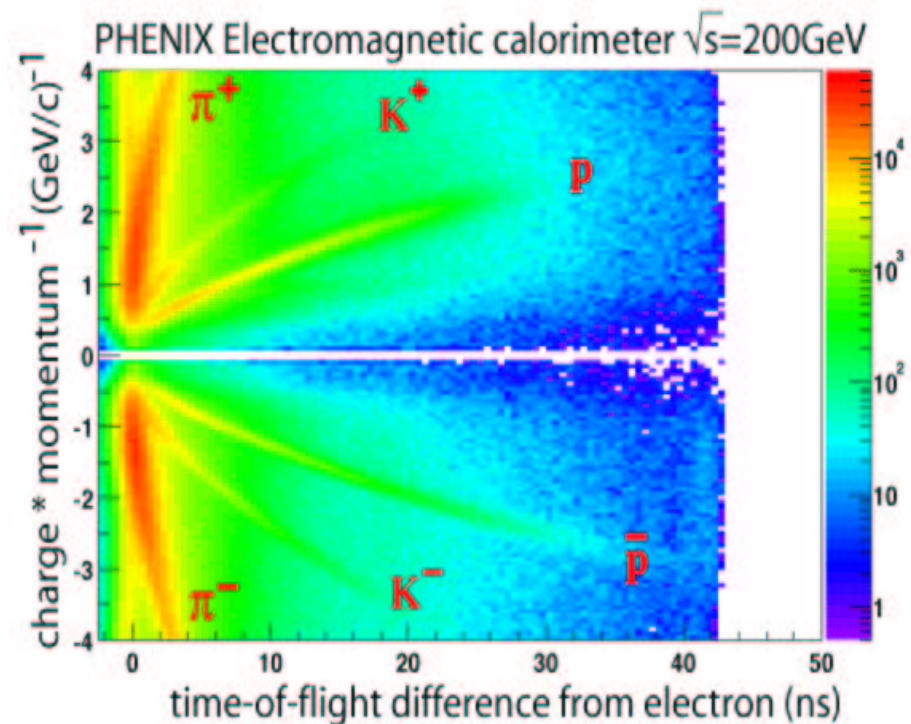
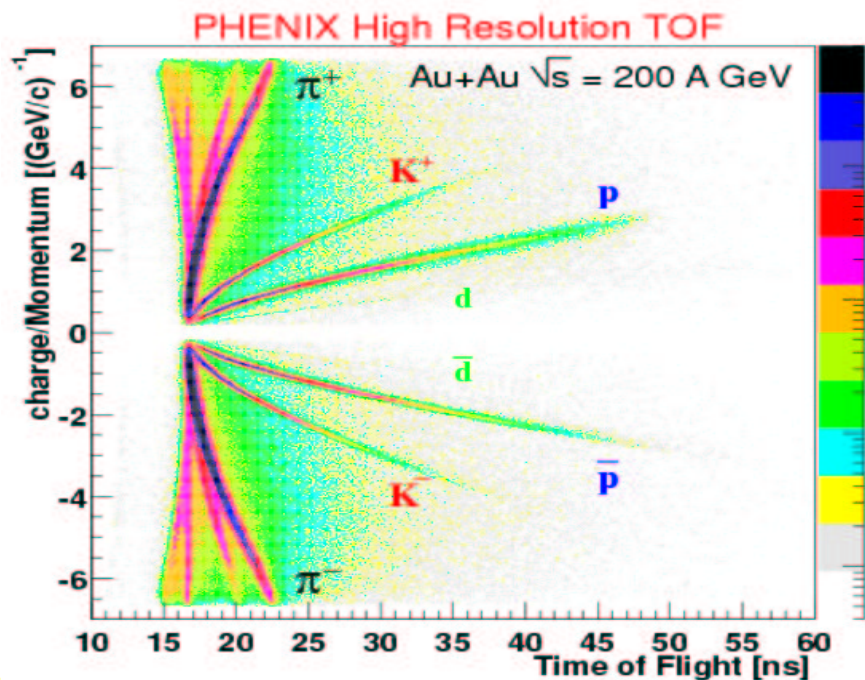
$$|\eta| < 0.35 ,$$

$$\Delta\phi = 45^\circ$$

b) EMCAL acceptance:

$$|\eta| < 0.35 , \Delta\phi = 2 \times 90^\circ$$

Hadron PID in PHENIX



Run 2:

TOF timing resolution: $\sigma_t \sim 120$ ps

K/π separation up to 2.0 GeV/c

Run3:

TOF timing resolution $\sigma_t \sim 140$ ps

K/π separation upto 1.6 GeV/c

Run 2 (Au -Au):

EMCAL resolution: $\sigma_t \sim 450$ ps

K/π well separated for $0.3 < p [\text{GeV}/c] < 1.0$

Analysis procedure

- Events:

- Trigger: Minimum-bias
- Vertex: $-30 < z_{\text{vertex}} \text{ (cm)} < 30$

$N_{\text{evt}} = 19.9 \text{ M (Au-Au)}$

$N_{\text{evt}} = 13 \text{ M (d-Au) (work in progress)}$

- Tracks

DC – PC

3σ spatial matching between detectors

2σ momentum-dependent PID cut for Kaons

- Pairs

All K are paired together to form N_{+-}

→ Signal + Combinatorial background (CB)

Combinatorial background determined by mixed event technique

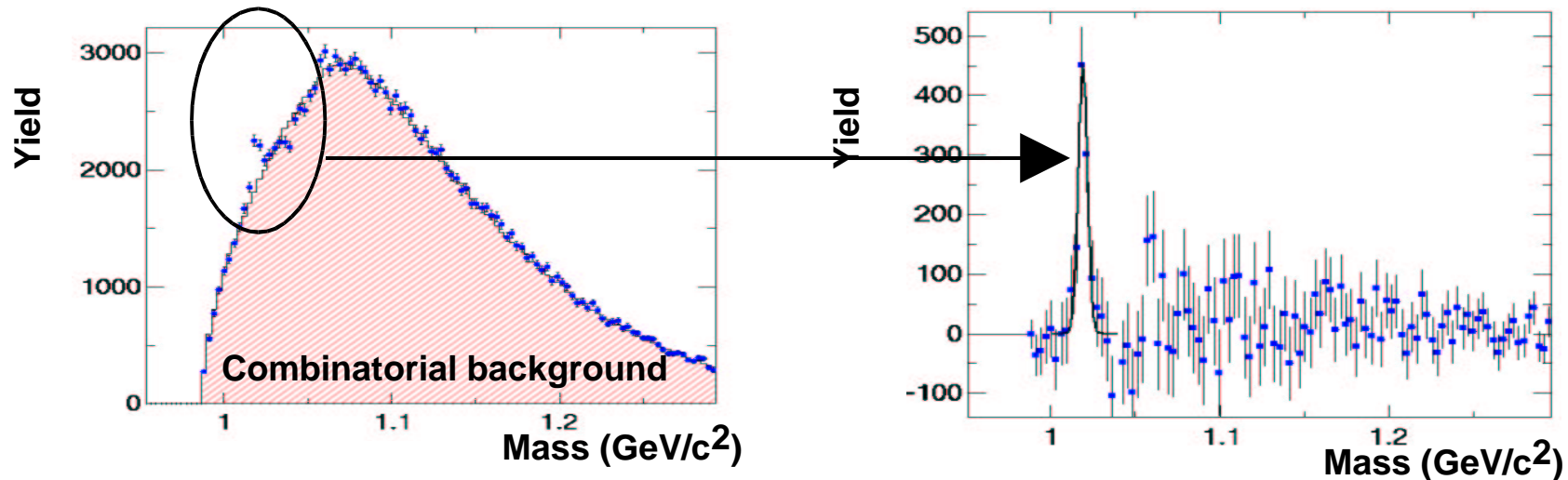
(mix + and – tracks from different events with same centrality and vertex and
normalize such that $CB = 2 \sqrt{[N_{++}N_{--}]}$)

Signal: $S = N_{+-} - CB$

Run2 Au–Au analysis

Au + Au minimum bias (0–92%) at $\sqrt{s_{NN}}=200$ GeV

Kaons are identified with TOF



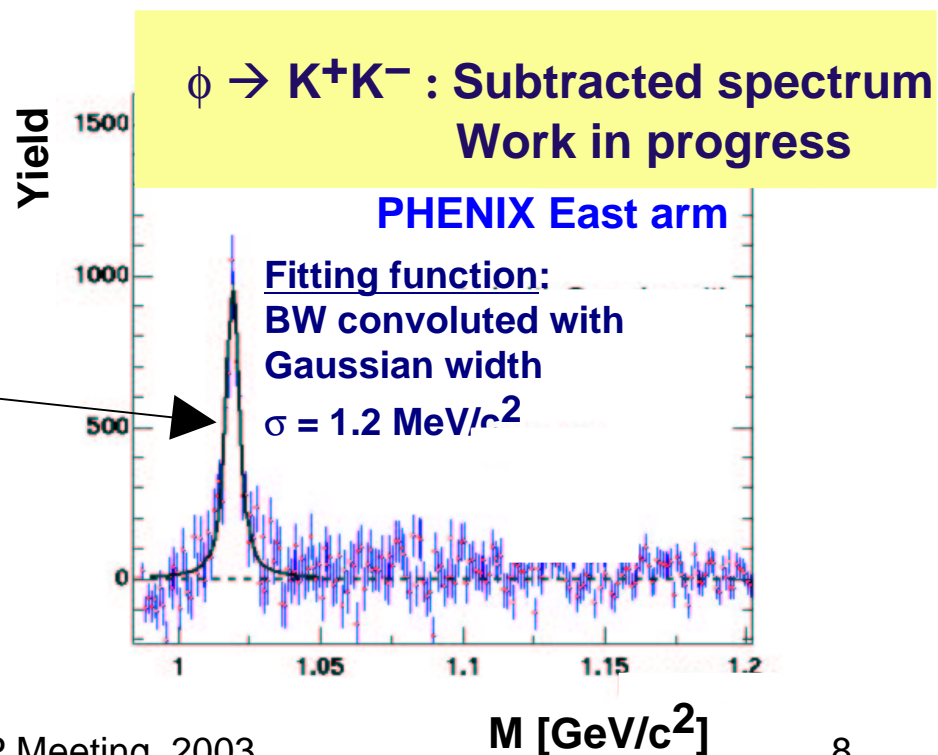
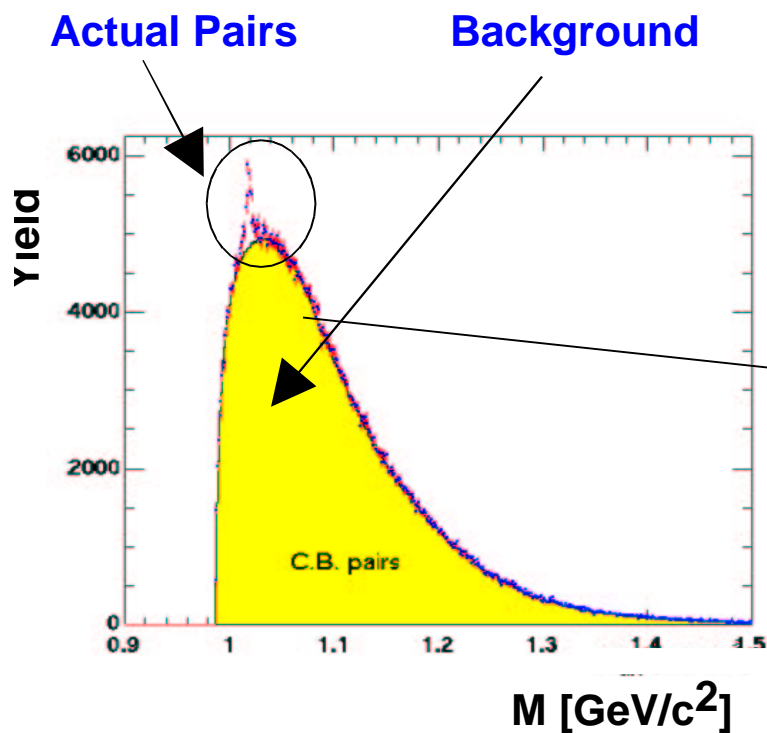
- Signal = 1135 ± 120
Signal / Background = 1 / 12
Mass peak and width agree within errors of PDG values.
- PHENIX Preliminary dN/dy at QM'02

$$\frac{dN}{dy} = 2.01 \pm 0.22 \text{ (stat)}^{+1.01}_{-0.52} \text{ (sys)}$$

Run2 Au–Au analysis: Present status

Current Au–Au analysis status (work in progress)

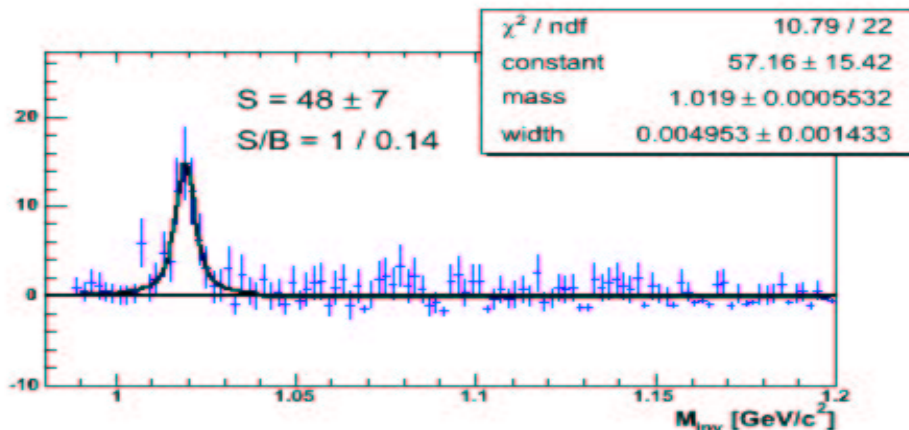
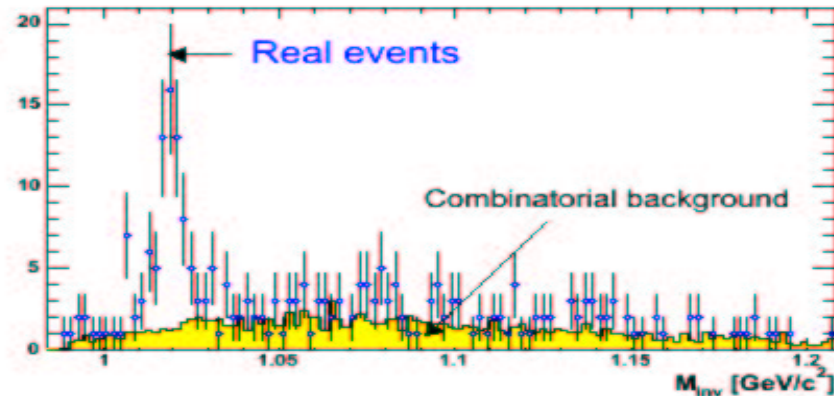
a factor of 5 higher statistics is achieved by including our EM Calorimeter PID



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Run3 d–Au analysis status: Work in progress

d–Au minimum–bias: Work in progress



- $N_{\text{evt}} = 13 \text{ M}$
 $< 10\%$ of the d–Au statistics
- Time of flight only
 $0.3 < p_{K_{\text{aon}}} [\text{GeV}/c] < 1.6$
- Fitting function:
 Breit–Wigner Convolved with Gaussian
- Number of ϕ reconstructed before any correction
 $N_{\phi} = 48 \pm 7$
- Signal–to–background ratio
 $S/B = 1 / 0.14$

Summary and outlook

A decorative graphic consisting of overlapping yellow, red, and blue squares with a black crosshair.

ϕ mesons are reconstructed by the PHENIX spectrometer for Au–Au and d–Au collisions at $\sqrt{s_{NN}} = 200$ GeV at RHIC.

The PHENIX setup allows us to measure ϕ meson spectra and yields using different independent subsystems.

The preliminary ϕ yields in Au–Au collisions were measured with time–of–flight detector only. Inclusion of the Electromagnetic Calorimeter arrays allows a high statistics measurement of dN/dy and line shape of the ϕ mesons.

The initial uncorrected ϕ – meson invariant mass spectra from d–Au minimum–bias events shows significant (and obvious) increase in the signal–to–background ratio in comparison with minimum–bias Au–Au events.

Significant improvement in $\phi \rightarrow K^+K^-$ analysis with transverse momentum spectra and yields for Au–Au and d–Au is expected soon.

